GUARANA

BY

PROSPER H. MARSDEN, F.C.S.,

LECTURER ON MATERIA MEDICA AND PHARMACY IN THE UNIVERSITY OF LIVERPOOL

(*Received for publication January 11, 1910*)

(Plate X)

Guarana is a Brazilian drug obtained from the seeds of a climbing plant of the natural order Sapindaceae, *Paullinia sorbilis*, Martius (*P. Cupana*, H. B. and K.). The name is derived from a tribe of Indians in the Amazon basin, and is pronounced with the accent on the last syllable, much like Panamà.

NOMENCLATURE

Paullinia,[1] Linn. Gen. ed. I, 116 (1737), Sapindaceae, Benth. and Hook, f. I, 394; Enourea, Aubl. Pl. Gui., I, 587 (1775); Semarillaria, Ruiz and Pav. Prod., iv. 52, t. 9 (1794).

Paullinia sorbilis, Mart. Reise Bras., i. 311, nomen = *P. Cupana*.

Paullinia Cupana,[2] H. B. and K., Nov. Gen. et Sp. V, 117, Venezuela.

The name Paullinia[3] is derived from C. F. Paullin, a German botanist, 1712. Shrubby tropical plants. About 125 species, mostly tropical America, one African.

Bentham and Hooker,[4] writing in 1862-1867, say of the genus: 'Species ad 80, nobis cognitae v. bene descriptae, Americam praesertim orientalem incolentes, quarum una in Africam occidentalem vagatur.'

Bentley and Trimen, Medicinal Plants, Vol. I, No. 67, give a coloured illustration of *Paullinia sorbilis*, Mart., which is reproduced (fig. I) by kind permission of Messrs. J. & A. Churchill.

HISTORY

The plant which yields guarana is abundant in the province of Amazonas, along the banks of the Tapajos, Rio Negro, as well as in

Guiana and Venezuela.[5] It has been used from time immemorial by the numerous tribes inhabiting the Amazon basin, in the form of powder made by grating the stick of guarana into water to make a refreshing drink.[6] 'Besides its medicinal properties, this substance has a reputation for affording a refreshing beverage similar in its effects to tea and coffee. It is grated into a powder, very like powdered cacao in appearance. Two spoonfuls of this powder are mixed in a tumbler of water, and this drink is regarded as a stimulant to the nerves, and, like strong tea or coffee, is said to take away the disposition to sleep.'[7]

Dorvault[8] states that guarana was first brought to Europe by Cadet de Gassicourt in 1817, and this date is confirmed by Tschirch.[9] It was not, however, until 17th September, 1822, that Mérat received a large consignment of the drug from M. Gomès. This was sent without any details as to its preparation, but mentioning that one or two drachms were rasped into a glass of water by means of a very rough bone, which was usually sold with the drug. Martius seems to have informed Mérat that the juice of the plant, roughly reduced to an extract, formed the guarana of commerce, and Mérat[10] adds that the odour of the sample suggested the presence of added cacao powder.

Hanbury[11] describes guarana as 'the basis of a favourite beverage in some parts of Brazil.' He does not seem to be aware of any special medicinal action of the drug, nor have I been able to find any further reference to it in any of his publications. Guarana is not spoken of in the standard text book of Pereira, [12] nor in an older work by Woodville.[13]

Preparation and Description

Guarana is official in the Spanish Pharmacopoeia[14] under the heading 'Paulinia,' where it is described as a product obtained by trituration with heat of the seeds of *Paullinia sorbilis*, Martius, a Sapindaceous plant of Brazil. Roundish, ovoid, or cylindrical masses of 150 to 200 grammes weight, brittle and of brownish-black colour externally, irregular, granular and of brownish-red fracture; occasionally the remains of the seed coat are met with, or specks of added fecula are seen. Characteristic weak odour and bitter and astringent taste. Should contain at least three per cent. of caffeine.

Therapeutic action astringent, tonic and analgesic. A well-known Brazilian work on Materia Medica[15] printed and published in Paris gives the following account of the drug:—'The fruits appear in capsules which, when ripe, are of a beautiful ruddy brown colour. The seeds, which are dark-coloured and almost the size of hazel nuts, are roasted, powdered and afterwards massed with some tapioca and water and are put into an oven to dry and become hard. This prepared guarana appears in the form of elliptical or cylindrical lobes of a red or ashy-grey colour with a bitter taste without appreciable astringency. It is hard, difficult to powder, but softens in water.' The Guarani Indians[16] prepare the guarana by first washing the seeds; they are then lightly heated to separate the kernel from the seed coat, complete separation being performed by beating the seeds, contained in bags, with sticks. They are then crushed upon a heated stone and made into a paste with water, to which is sometimes added cacao powder or manioc flour. This paste, moulded into cakes or cylinders, is then exposed to the sun or submitted for several weeks to a gentle heat.

Tschirch[17] states that Guarana in sticks comes over in chests of 65 kilos.

The cylindrical form is that in whieh the drug is usually seen, and Fig. 3 taken from portions of two such pieces (No. 463) in the Museum of Materia Medica of the University of Liverpool, gives a fair idea of this form. Fig. 2 shows a specimen (No. 288) of the seeds in the same collection.

In addition to the forms mentioned above, guarana is occasionally seen in this country in other shapes, such as those of fish, animals, models of the plant yielding the drug, and of other plants. This is well seen in Fig. 4, taken from a specimen (No. 806) presented to the above Museum by Dr. H. Wolferstan Thomas. This is a model of the fruit, of the plant yielding the seed, from which the beverage cocoa is prepared, *Theobroma Cacao*, L. Dr. Thomas tells me that he has frequently seen specimens of the drug in these curious forms, and that it is worth about three shillings a kilo. In 1871 it was worth about eight pence a pound, and could be bought on the Rio Negro at as low a rate as a penny a pound. The present market price is about twelve shillings a pound.

The paste used in making these models is finer than that used

for the other forms in which the drug is sold, and the models are neatly executed.

Holmes[18], referring to a specimen in the Museum of the Pharmaceutical Society of Great Britain, says:—'This specimen, presented by Dr. Wilks, is accompanied by a letter from Mr. G. H. Brandt stating that it has been carved by the Indians into the shape of a fish called the Piraruceu (*Arapaima gigas*, Cuv.), the tongue of which is used for grating the Guarana. The tongue is also used by them as a file for grating several of their hard odoriferous roots. Amongst these is the root of the Piperiocca, which, when reduced to powder, they use for washing and perfuming their bodies. The so-called tongue consists of a long bony plate, nearly six inches long by one and a quarter broad, densely covered with bony papillae, about a quarter of an inch high and half a line broad. See *Cuvier and Valenciennes*, Hist. Poiss., XIX, pp. 441-461, with fig.; *Agassiz and Spix*, Pisc. Braz., p. 31.'

It is probable that this bony plate is a similar one to that mentioned by Gomès.

Tschirch[19] speaks thus of the curious forms in which drugs are sometimes seen: 'At times the finished products are further worked up. From Caoutchouc and Guarana paste, were formerly made all sorts of curious figures, but now Guarana is usually seen in sticks.' He illustrates this in the case of Caoutchouc.

Microscopic Characters

These are well described by Planchon and Collin, and consist chiefly of swollen starch grains, needle-shaped crystals, small polygonal cells, and characteristic sclerenchymatous cells.

Chemical Constituents

'The active chemical principle is an alkaloid first discovered by Dr. Theodore von Martius, and called by him guaranine, but since shown by Dr. Stenhouse[20] to be identical with theine. Guarana shows more than double as much of this alkaloid as good black tea, and five times as much as coffee, the proportions being 5·07 per cent. in guarana, 2·13 per cent. in tea, and 0·80 per cent. in coffee. The same alkaloid is found to the amount of 1·25 per cent. in Matè, or Paraguay tea, the produce of several species of *Ilex*.

It is rather a singular coincidence that the same alkaloid should prevail in all the principal substances employed in a similar manner as beverages in different parts of the world—in the tea of China and India, the coffee of Arabia, the Cacao of Central America, the Matè of South America, and the guarana of Brazil. M. Fournier[20] has found in the last-named substance, besides tannate of caffein, the following principles:—Gum, starch, an acrid green fixed oil, a concrete volatile oil scarcely soluble in water, a peculiar principle not precisely determined, and tannic acid.'

Tannic Acid was found in guarana by F. V. Greene,[21] and he describes the reactions of this as 'strikingly dissimilar from those of tannic acids generally.' Thoms,[22] in 1894, found in guarana 8·63 per cent. of moisture. Later work by E. Kirmsse[23] showed the presence of tannin. From the crude tannin this worker obtained crystals of a catechin the properties and reactions of which were found to be identical with that of Pegu catechu. The author confirms Thoms's statement that the amount of caffeine in guarana has been over estimated; three samples were found to contain 2·68, 2·97 and 3·10 per cent. respectively. Cocoa, which has been stated to be an adulterant of lower grades of guarana, was not detected in any of the samples.

Oesterlen[24] notes also the presence of a resin, and says that the tannin of guarana appears to act like that of Monesia and Rhatany.

A large number of authorities[25] have reported the presence of *Caffeine*, which is the most important constituent of guarana, and identical with guaranine and theine. In 1853 Oesterlen[26] refers to a special indifferent crystalline substance guaranin. Hanbury[27] speaks of caffeine as a constituent of guarana. There is some variation in the statements of authorities as to the percentage of caffeine present, thus we have the following data:—

In 1886, 4·5 per cent. Bochefontaine and Gusset.[28]
3·72 to 5 or 6 per cent. Kremel, Feemster, Squibb and Flückiger.[29]
1888, 3·12 to 3·80 per cent. A. Kremel.[30]
1894, 2·6 per cent. Thoms.[31]
1897, 4·32 to 4·68 per cent. C. H. La Wall.[32]
2·5 to 5 per cent. Humphrey[34] and British Pharmaceutical Codex.[35]

Ash

The yield of ash is stated to be:—

In 1886, 1·36 per cent. H. Warnecke.[36]

1888, 1·30 to 2·00 per cent. Kremel.[37]

1894, 1·68 per cent. Thoms.[38]

I have been unable to find any further reference to the peculiar principle mentioned above by Fournier.

Medicinal Properties

Oesterlen,[39] in 1853, states that the powdered seeds were given for diarrhoea and similar complaints by Ritchie in the dose of one drachm per diem (Ed. Journ., May, 1852). Dorvault[40] says that guarana was introduced as a tonic and astringent, which is the use made of it in Brazil, and that it has been advocated as a remedy for neuralgia and migraine. A dose of 4 to 8 grammes was given, and there was a stock of it in the French pharmacies in 1867, when it was made into two syrups, tincture, pills, ointment and a chocolate. Chernoviz[41] mentions that guarana is prescribed as medicine in various affections, chiefly in diarrhoea and dysenteries, in doses of two drachms in eight ounces of water. Speaking of guarana in 1872, a writer in the Year Book of Pharmacy[42] says:—'This drug is now attracting attention as a remedy for sick headache. It has been long known, but has never come into general use.' Mr. Harold Wyatt, who has had some years' training in French pharmacy, tells me that the drug is more used in France than in England, and my own experience of the two countries proves the same, as since 1884 I have seen guarana prescribed but three times, in cachets, and two of these occasions were whilst I was in France, but it appears that the elixir is sold to a considerable extent in Liverpool. Guarana is official in the pharmacopoeias of Austria, Belgium, Dutch Supplement, France, Hungary, Italy, Mexico, Portugal, Spain and U.S.A.,[43] and our own British Pharmaceutical Codex[44] has a monograph upon it, in which it says:—'Guarana is used for the same purposes as caffeine; it has a reputation in sick headache, and is sometimes used as an astringent in diarrhoea and dysentery. The drug is used in powder form, being given in a cachet or mixed with water to form a draught. Elixir of guarana is a pleasant liquid form of the drug. Tincture of guarana is suitable for use in mixture form. Dose: Half to one gramme.'

The Addendum to the Austrian Pharmacopoeia VIII[45] has a Pulvis Guaranae Compositus of the following composition:—Pulv. Guaranae 5, Sodii Salicyl. 3, Quininae Sulph. 2, in capsules each to contain a gramme.

The United States Pharmacopoeia[46] has a standardised preparation, Fluidextractum Guaranae, containing 3·5 per cent. alkaloid made by percolation with diluted alcohol. The average dose is half a drachm.

Allied Plants

The natural order Sapindaceae, and particularly its sub-order Sapindeae, includes many interesting plants having medicinal action.

Em. de Maout and J. Decaisne[47] state that *Serjania* and *Paullinia*, American genera, are poisonous; the Brazilians use their juice to stupefy fish.

Paullinia cururu. The juice of this plant is used by the natives of Guiana to poison their arrows.

P. pinnata, L. A poison is prepared from the root and seeds, and the expressed juice of its leaves furnishes the Brazilian Indians with a powerful vulnerary.'[47], Créteur[48] says that *P. pinnata*, L., is a powerful climber, the seeds of which are used as a stupefacient in the Antilles and Brazil, and act upon fish in the same way as the Coque du Levant (*Cocculus indicus*). The leaves, called 'eururu ape,' are vulnerary. *P. pinnata*, L., is also one of the drugs called 'Timbo,' which is the name given in Brazil to several plants, such as *Serjania cuspidata*, *S. lethalis*, of the order Sapindaceae, and *Tephrosia toxicaria*, and *Physalis heterophylla* of the order *Leguminosae*, all of which are used for the purpose of stupefying fish. A decoction of the root is preferred, as affording the more powerful poison.

Planchon and Collin[49] state that the bark usually used for fish poisoning in Brazil is that of *Serjania curassavica*, Radk. (*P. senegalensis*, Jus., *P. africana*, Don.), and give Martius as authority for the statement. This plant grows in Brazil, Mexico, Guiana, the Antilles and West Africa. *P. pinnata* is also reported as growing in West Africa.[50] *P. costata*, Schl., is used in Mexico to kill fish.[51] *P. mexicana*, L., or quarhmeteatl of the Mexicans, possesses the virtues of sarsaparilla in the treatment of rheumatism and syphilis.[52]

Greshoff[53] gives a very complete list of Indo-Malay poisons, and amongst them are *Serjania*, *Cupania* and *Paullinia*.

LITERATURE

1. Index Kewensis, Oxford, 1894, Vol. II, p. 438.
2. id. ib. p. 439.
3. Lyons, A. B. 'Plant Names,' Detroit, 1907, p. 341.
4. Bentham, G., and Hooker, J. D. 'Genera Plantarum, 1862-1867,' Vol. I, p. 394, where many other references are to be found
5. Cooke, M. C. Guarana, *Paullinia sorbilis*, Mart. Pharm. Journ., 3rd series, 1, 221. Year Book of Pharm. and Trans. of the Brit. Pharm. Conf., 1871, p. 41.
6. Planchon, G., et Collin, E. 'Les drogues simples d'origine végétale,' Paris, 1896, Tome II, page 575.
7. Cooke, M. C. Loc. cit.
8. Dorvault. L'Officine, ou réperatoire général de Pharmacie pratique, 7e éd., 1867, p. 530.
9. Tschirch, A. Handbuch der Pharmacognosie, Leipzig, 1909, Band I, S. 24.
10. Mérat, F. V., et De Lens, A. J. Dict. universal de Matière méd. et Ther. Gén., Paris, 1831. Tome III, p. 436.
11. Hanbury, Daniel. Science Papers, 1876, p. 87.
12. Pereira, Jonathan. The Elements of Materia Medica, London, 1840.
13. Woodville, William. Medical Botany, London, 1790 to 1794.
14. Farmacopea oficial española, 7th ed., 1905. (For translation of this from the Spanish and of the following reference from the Portuguese I am indebted to Mr. Harold Wyatt, Bootle.)
15. Chernoviz. Formulario ou Guia Medica, Paris, 1868, p. 377
16. Planchon et Collin. Op. et loc. cit.
17. Tschirch, A. Op. cit. I. 207.
18. Holmes, E. M. The Museum Report, Pharm. Soc. Great Britain, 1903, p. 61.
19. Tschirch. Op. cit. I. 207.
20. Cooke, M. C. Loc. cit. refers to Stenhouse, Pharm. Journ. (I), xvi, p. 212; Fournier, Journ. de Pharm., April, 1861, p. 291.
21. Greene, F. V. Amer. Journ. of Pharm., August, 1877, Y.B., 1878, p. 70.
22. Greenish, Henry G. An introduction to the study of Materia Medica, London, 1899, p. 136.
23. Kirmsse, E. Archiv. der. Pharm., 1898, ccxxxvi, 122-141, Y.B., 1899, p. 153.
24. Oesterlen, Fr. Handbuch der Heilmittellehre, Tubingen, 1853, s. 389.
25. Redwood, Theophilus. Gray's Supplement to the Pharmacopæia, 2nd ed., London, 1848, p. 815, refers to Journ. de Pharm., 1840, vol. xxvi.
26. Oesterlen, Fr. Op. et loc. cit.
27. Hanbury, Daniel. Op. et loc. cit.
28. Bochefontaine et Gusset. Chem. Tech. Central. Anzeiger IV. 322, Y.B., 1886, p. 195.
29. Planchon, G., et Collin, E. Op. cit. II, p. 577.
30. Kremel, A. Pharm. Post., 1888, p. 101; Y.B., 1888, p. 93; Archiv. der Pharm. (3) xxvi, 318; Journ. Chem. Soc., August, 1888; Y.B., 1889, p 108.
31. Greenish, Henry G. Op. et loc. cit.
32. La Wall, C. H. Amer. Journ. Pharm., 1897, pp. 350, 351; Y.B., 1898. p. 166.

34. Humphrey, John. Mat. Med. and Pharmacy, London, 1907, p. 208.
35. Brit. Pharm. Codex, Pharm. Soc., London, 1907, p. 490.
36. Warnecke, H. Pharm. Zeitung, Sept. 8, 1886, Ph. J. (3), XVII, p. 330.
37. Kremel, A. Loc. cit.
38. Greenish, Henry G. Op. et loc. cit.
39. Oesterlen. Op. et loc. cit.
40. Dorvault. Op. et loc. cit.
41. Chernoviz. Op. et loc. cit.
42. Y.B. of Pharmacy, 1872, p. 27.
43. Squire. Pocket Companion Brit. Pharm., London, 1904, p. 321.
44. Brit. Pharm. Codex, p. 491.
45. Review of Pharm. Aust. VIII; in Y.B., 1907, p. 273.
46. Martindale and Westcott. The Extra Pharmacopœia, 13th ed., London, 1908, p. 399.
47. Le Maout, Em., et Decaisne, J. A General System of Botany. Translated by Mrs. Hooker, London, 1876, p. 354.
48. Créteur, M. L. 'Paullinia: Properties of some species of Paullinia,' Bull. Soc. Pharm., 1870, p. 123; quoted in Y.B., 1870, p. 87.
49. Planchon et Collin. Op. cit. II, 378, and Y.B., 1892, p. 152.
50. Holmes. Mus. Rep., 1907, p. 81.
51. Catalogue Med. Plants., Pharm. Soc. Great Britain. No. 238, p. 34.
52. Créteur. Loc. cit.
Planchon et Collin. Op. cit. III, 578.
53. Greshoff. Indo-Malay Poisons, Brit. and Col. Druggist, Jan. 30, 1903, pp. 108-9, quoted from Ber. d. Ph. Ges.; S.d. Ap. Ztg., 1903, 31.

Fig. 1.

Paullinia sorbilis, Martius.

Fig. 2.

Seeds of *Paullinia Cupana*, H. B. & K.

Fig. 3.

Guarana in sticks.

Fig. 4.

Guarana paste in form of fruit of *Theobroma Cacao*, L.

p. p. Press. Imp.